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AUTHOR Bishop, John
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ABSTRACT

A study compared different firms' methods of recognizing and rewarding employee performance and examined the impact of such recognition and reward on such factors as involuntary and voluntary labor turnover and worker productivity. Data from a survey of 3,412 employers that was sponsored by the National Institute of Education and the National Center for Research in Vocational Education in 1982 indicated important differentials between firms with respect to the prevalence and power of merit-based pay. Although workers' reported productivity relative to peers had important and reasonably rapid effects on relative wage rates at small- and medium-sized nonunion establishments, it had almost no effect at unionized establishments with more than 100 employees and at nonunion establishments with more than 400 employees. Relative wage rates did respond positively to the large differences in productivity between workers doing the same job; however, these responses were incomplete. When considered against the background of the inevitability of significant errors in measuring productivity, the wage differentials of employees with about 1 year of tenure create a strong a priori case that compensation for greater productivity is often only partial. (An appendix to this report describes the data collection measures and sample population on which the study's conclusions are based.) (MN)

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THE RECOGNITION AND REWARD OF EMPLOYEE PERFORMANCE

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by

John Bishop

Associate Director: Research

The National Center for Research in Vocational Education
The Ohio State University
1960 Kenny Road
Columbus, Ohio

After August 1986

New York State School of Industrial and Labor Relations
Cornell University

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THE RECOGNITION AND REWARD OF EMPLOYEE PERFORMANCE

Most hiring selections are based on very incomplete information. In part this is a consequence of the remarkably small investment that most employers make in their hiring decisions. Small employers, for example, consider on average only 9 applications, interview only 4.5 applicants and devote less than 10 hours of staff time to filling each position (Barron and Bishop 1986). Even more important is the notorious unreliability of most predictors of job performance such as the interview. Mayfield (1964) concludes a review of the literature with the statement "the interview as normally conducted in a selection situation is of little value (p. 249)." Recipients of job offers are also poorly informed about many features of the job and about their alternative opportunities.

The poor quality of the information available when hiring decisions are made means that the terms agreed to may need to be changed if non optimal separations are to be avoided (Hashimoto and Yu 1980). Negotiation costs increase with tenure, however, because the individual develops firm specific human capital and the rents to be divided grow in size. Consequently formal renegotiation of employment contracts and its cousin, offer matching, are uncommon except for occupations such as sports, art and research where productivity is both highly visible and highly variable. More common are long term contracts in which the more reliable party--the employer--promises to award wage increases and promotions on the basis of performance. This contract form is by no means universal, however, and even where it prevails there are often severe constraints on how key features of the contract such as the wage vary with measured performance. What are the optimal parameters of such contracts?

Why is the compensation for job performance so often deferred? How prevalent are such contracts? What are their terms? What is the effect of a worker's relative productivity on his/her relative wage? Which firms are likely to offer such contracts? What are the implications of such contracts for dismissal and quit probabilities? How quickly do the better performers get promoted? These are the questions to be addressed in this paper.

The paper is organized as follows. Section 1 is a discussion of the factors which influence the optimality of contracts in which the employer awards bonuses or wage increases that depend on measures of job performance. Section 2 presents data on the amount of variation in rates of pay and productivity between workers in the same job. Section 3 examines the degree to which employer perceptions of job performance influence relative wage rates. Estimates of the elasticity of relative wages with respect to relative productivity (as perceived by the wage setter) and how it varies by establishment size, unionization, occupation, and the size of the local labor market are presented. The impact of job performance on voluntary and involuntary turnover and how this varies across firms is examined in section 4. Section 5 examines how promotions depend on job performance and how this varies across firms. Section 6 summarizes the empirical findings, relates them to the theories discussed in section 1 and speculates on policy implications.

1. The Optimal Relationship between Productivity and Wage Rates

The widespread use of formal performance appraisal implies that most employers believe they can rate the productivity of their employees. Adjusting relative wage rates to reflect relative productivity produces three kinds of benefits for the firm. First it serves as an incentive for greater effort.

Secondly, it tends to attract to the firm more able workers and those who like to work hard (Freeman 1977). Thirdly, it reduces the probability of losing the best performers to other firms and raises the probability that the least productive workers will leave. On the other hand, information on a worker's effort and productivity are often costly to obtain, and the information assymetries that these costs create often make it optimal to limit the adjustment of the wage rate to productivity. There are at least 6 reasons for this:

- o The inevitability of significant errors in measuring productivity
- o Variations over time in a worker's relative productivity
- o Productivity differentials that are either specific to the firm or not visible to other employers
- o Risk aversion
- o Deferred compensation of outstanding performance
- o Other forms of reward for greater productivity

Measurement Costs

The first explanation is the high cost of accurately measuring a particular worker's productivity. In most jobs, an objective measure of productivity simply does not exist. This is part of the reason why in November 1975, only 1.2 percent of the nation's workers were paid on a piece rate basis and only 1.9 on a pure commission basis (Flaim 1976). In most work environments, productivity-based wage setting would have to use subjective evaluations by immediate supervisors. These supervisory assessments are known to contain measurement error. Meta-analyses of supervisor rating studies have found that 0.6 is the upper bound on the correlation between the ratings given the same worker by two different raters (King, Hunter, and Schmidt 1980). A more

recent meta analysis of supervisor rating studies finds the average correlation between ratings to be .47. Even more significant are the even lower correlations of supervisor ratings with carefully designed work sample measures of performance. The mean correlation is .42 in studies of civilian jobs and .27 in studies of jobs in the armed forces (Hunter 1983).

If the purpose of merit pay is to forestall the loss of the most productive employees and the firm's measure of productivity is subject to error, the optimal wage setting rule results in wages only partially adjusting to measured differences in productivity (Hashimoto and Yu 1980). If we take .42 to be a lower bound on the correlation between supervisor ratings and true productivity (r_{ot}) in civilian jobs and make some assumptions about the structure of measurement error, an optimal wage setting rule may be calculated.[1] If measurement error ($u = p^o - p^t$) is uncorrelated with true productivity, an $r_{ot} = .42$ implies that the slope of the relationship between expected true productivity $E(p^t)$ and measured productivity p^o is $\partial E(p^t)/\partial p^o = (.42)^2 = .176$.[2] However, this estimate of the slope is too low, because the measurement errors in scales like job performance which are subject to floors and ceilings are negatively correlated with true productivity. It is reasonable to expect high producers to be more likely misclassified as low producers than as super high producers and for low producers to be more likely misclassified as high producers than as super low producers.

The assumption of uncorrelated error and $r_{ot} = .42$ also produces an unreasonably low estimate of .176 for the ratio of the variances of true and observed productivity. If we instead assume that $r_{ot} = .42$ but that the two variances are equal,[3] the slope of the wage setting rule is $\partial E(p^t)/\partial p^o = .42$.[4] Both the .176 and .42 estimates of the optimal wage setting parameters must be

viewed as lower bounds on the correct number for the assumed .42 correlation between true productivity and the supervisor report is a lower bound on the true value of this parameter.

Productivity varies over time. One of the reasons why productivity is difficult to measure is that it varies over time. The consistency of worker performance is greatest when conditions of work are stable. When pay for a routine task is based on an incentive system, correlations of output rates for adjacent weeks run as high as 0.96 (Tiffin 1942; Rambo, Chomiak, and Price 1983) and as low as 0.68 (Rothe 1978). The average correlation for 8 different studies was 0.86. Most jobs are not paid on an incentive, however, and conditions of work are often changing. In more typical environments where pay is not based on an incentive and the work environment is changing, correlations for adjacent weeks ranged from 0.48 (Rothe and Nye 1961) to 0.69 (Rothe 1947), and over 4 studies averaged 0.585. Whether correlations for quarterly or yearly averages would be higher or lower than this can be debated. Using longer time intervals should increase the consistency of performance, but the longer time intervals between measurement will reduce the correlation (Rambo, Chomiak, and Price 1983). These results imply that if employers try to forestall the loss of their most productive employees by setting wage rates equal to next period's expected productivity, the lack of performance consistency will result in an elasticity of future wage rates with respect to current productivity that is less than one.

The lack of performance consistency over time accounts for some of the differences between supervisor ratings of the same employee, so averages of past ratings are likely to be a better predictor of future performance than any single rating. Supervisor ratings, however, are influenced by previous

ratings so errors in measuring performance are not independent. Workers develop reputations (that may not be deserved) which influence later supervisors. Consequently, averaging ratings from many different years only moderately improves the employers ability to predict next period's true productivity.

Differentials that are specific to the firm. Third, productivity differentials between workers at a firm might reflect differences in skills that are specific to the firm or only know to the firm. If the worker is not able to translate high productivity at the current employer into a higher wage offer at another firm, the competitive pressure on the current employer to raise the individual's wage is reduced. Even if all productivity differentials within the firm reflect differences in generalized competence, it is very difficult in most jobs for other employers to measure these differentials accurately and thus base wage and job offers on them. Most of the sources of information available to other employers are not reliable. Self-reports of productivity are properly treated with skepticism. References from past employers tend to be bland. Separating employees who have felt that they were unable to get a good job because of a poor recommendation have successfully sued their previous employer. This has made most employers reluctant to talk about their past employees. An illustration of this reluctance is provided by the following quote:

> "We warn our managers all the time. If someone calls you on the phone and asks you about someone who has left the company, you refer them to personnel. You don't say word one to them. You could be put in the position where you are going to be in court some day." (Personnel Director, Nationwide Insurance, Columbus, 1985)

In the U.S. it is the custom at most firms for performance appraisals to be confidential. Avoiding morale problems has been cited as one reason for

this confidentiality. A second reason is the impact of confidentiality on turnover when wage rates only partially reflect a worker's productivity. Maintaining confidentiality is advantageous to both the firm and the worker. The employer does not want other employers to know which of his employees are the most productive because that increases the risk of losing the best performers. Neither does the employer want other employers to know which employees are least productive because that reduces their ability to find another job and therefore their probability of leaving. Employees who are told their performance is poor have the same interest as the employer in keeping the information private. Employees who learn their performance is above average would, after the fact, like the information to be public, but performance signals cannot be made public only when they signal high productivity for their absence then becomes a signal of low productivity. The employee agrees to a contract which specifies confidential performance appraisals because the benefit of suppressing the news when it is bad outweighs the benefit of publicizing the news when it is good. The reason the worker believes suppressing bad news is more important then publicizing good news is (1) that his/her chances of leaving the firm go up when the boss perceives productivity to be low and (2) the worker is risk averse--large reductions in earnings lower utility by more than an equally large increases in earnings raise utility.[5]

Thus a major share of the productivity differences between workers at the firm are either irrelevant to or invisible to other employers and hence are functionally specific to the firm. The optimal response of within firm wage differentials to measured differences in expected productivity specific to the firm is equal to the worker's share of investments in specific human capital

(Hashimoto and Yu 1980). In Bishop and Kang's (1984) model of wage determination the sharing ratio is 1/1+θ where:

$$\theta = \left(\frac{1+r_{firm}}{1+r_{person}}\right)\left(\frac{\frac{\phi_o}{Pr(k)}}{\frac{\phi}{Pr(s)}}\right).$$

The required rates of return for the firm and the worker are respectively, r_{firm} and r_{person}. $\phi_o/P_r(k)$ is the proportionate change in the probability of not being dismissed per unit change in 2nd period wage rate, $\phi/Pr(s)$ is the proportionate change in the probability of not quitting per unit change in the wage. When quits are highly responsive to the wage and fires are not, wage differences reflect differences in specific productivity. When fires are more responsive to the wage than quits are, wages respond less to differences in specific productivity.

Risk aversion. A fourth reason why the contracts that govern the employment relationship may specify only partial adjustment of relative wages to relative productivity is worker risk aversion. Realized productivity is often influenced by random factors such as the territory, machine, or co-worker to which the worker is assigned. Setting up a compensation scheme which varies wages dollar for dollar with realized productivity establishes the correct incentives for effort but forces the worker to accept a great deal of risk. The worker's risk aversion leads him or her to prefer contracts that are not conditioned on realized productivity. The optimal contract in such an environment will be a compromise between full and zero incorporation of realized productivity into the wage. Exactly where the compromise is struck depends upon the strength of worker risk aversion, the responsiveness of effort to reward, and the variance of the random element (Cheung 1969; and

Stiglitz 1974; 1975). If firms can monitor the worker's effort, worker risk aversion will induce firms to offer contracts in which pay is based primarily on effort rather than on realized output (Harris and Raviv 1979).[6] This further reduces the dependence of wages on realized productivity.

Risk aversion also reduces the dependence of pay on past productivity when effort is exogenous and the purpose of merit pay is the retention of the firm's most productive employees. Freeman's (1977) model of wage trends in the research industry assumes that the worker, his/her employer and other employers are all equally able to assess a worker's productivity. The researchers who make discoveries in the first period are paid a second period wage equal to their expected productivity but those not making discoveries receive a wage that is greater than their expected productivity. Wage differentials are thus smaller than the differences in expected productivity during the 2nd period. The rents paid the low performers in the second period are generated by underpaying all researchers in the first period.

Deferred compensation. A fifth reason for expecting the immediate response of relative wage rates to relative productivity to be small is that extra compensation for outstanding performance is often deferred. A merit increase in year 1 raises wage rates in later years even if the outstanding performance of year one is not repeated. Consequently, for workers anticipating long tenure (or expecting to retire on a defined benefit plan keyed to salary in the last few years), the present value of a merit increase is considerably greater than its first year impact. If anticipated tenure is short, however, deferred rewards for outstanding performance will not be attractive to a worker. This implies that firms with high rates of turnover would find that bonuses provide a more effective motivation for effort than a

merit increase. And indeed, bonuses and commissions are a common form of compensation in such high turnover occupations as selling automobiles and insurance.

The primary reason for deferring rewards for productivity is its impact on turnover. Deferring rewards strengthens the incentive for outstanding performers to stay and generates incentives for weak performers to leave. The very fact that the payment is delayed has this effect. An additional reason for deferring performance rewards is that it is easier to keep a small permanent wage increase confidential than a large immediate bonus. Managers who receive performance based bonuses do not want individual bonus awards to be made public. In one survey of 230 managers receiving bonuses, 57 percent wanted the range of awards to be made public but 95 percent wanted individual amounts to remain confidential (Lawler 1981). Firms and workers find it advantageous to keep merit increases and bonus awards confidential for the same reasons they find it advantageous to keep performance appraisals confidential.

Other forms of compensation. A sixth reason why differences in relative productivity may not be reflected in wages is that the firm is recognizing the greater output in ways that are not as visible to those outside the company. Promotions and higher relative wage rates are often justified on the grounds that they will reduce the probability of losing that employee. But, they also transmit signals to other employers about the employee's productivity, and consequently, raise the wage the promoted employee is likely to be able to obtain elsewhere. This means that as an instrument for retaining the most productive employees, promotions and wage increases are partially self-defeating. Rewards for performance that are less visible to other potential

employers such as praise, desirable job assignments, greater autonomy, being able to select subordinates, and opportunities for travel and vacations may have larger effects on retention and morale than equivalently costly wage increases.

A variant on this explanation has been proposed by Frank (1984). He posits that a workers' satisfaction with a job (utility) is influenced by his/her relative status in the firm or among co-workers as well as the absolute level of the wage. If so, a merit increase or promotion generates two kinds of benefits for the worker: a somewhat higher wage and a movement up the firm's status hierarchy.[7] The greater the perceived importance of relative status, the smaller are the wage increases necessary to motivate workers to put out maximum effort.

Performance rewards may also be provided by co-workers if the right team spirit prevails. The respect of one's co-workers is a very important component of self-esteem. Numerous studies of the workplace have found that the norms of the work group can often defeat management's attempt to induce employees to put out greater effort. Many of the successful firms described by Peters and Waterman (1983) have achieved the opposite: an organizational ethos which values excellence in one's co-workers and accords it respect. If the individual's survival, status or compensation depend on the success of the group, peer norms tend to appear which honor the members of the group who make especially large contributions to the team goal. Athletic teams, squads of soldiers during wartime, and family firms develop this kind of motivation as do work groups rewarded on a group incentive basis. Group incentives are especially effective forms of compensation when peers are better than management at assessing the effort and performance of individual workers. If

colleagues honor and respect outstanding performers, the salary increment for performance need not be as great and the result is a salary structure that only partially reflects the greater contribution of the outstanding performers.[8]

While the team spirit explanation of flat wage structures has some similarities to the relative status explanation, the welfare implications of the two stories are very different. Frank is analyzing a zero sum game in which a status gain for one person necessarily results in a status loss for others. Team spirit is a positive sum game. If team spirit makes the team more effective, the team will have more profits to share. But more fundamentally, honoring someone else for their accomplishments does not have to diminish one's own self-esteem. A leader or an organizational climate which induces workers to appreciate and support the efforts of co-workers raises the utility of all workers regardless of whether it increases profits.

In summary many factors influence the optimal relationship between a worker's relative productivity and his/her relative wage. An optimal contract will adjust wage rates more completely to reflect observed differences in relative productivity when:

- Effort is responsive to merit based pay.
- Achievement oriented and hard working job candidates seek to work at firm's that reward performance.
- Relative productivity can be measured accurately at low cost.
- Relative productivity is a stable trait. This makes measures of past productivity a good predictor of future productivity.
- Differences between workers in observed productivity are not specific to the firm. They reflect differences in personality or skill which determine productivity in other firms as well.

- Productivity differences between the employees of Firm A are visible to other employers.
- Worker risk aversion is weak.
- Turnover is high.
- An employee's probability of quitting is highly responsive to wage rates.
- Concern about relative status is weak.
- Merit increases and the wage rates of individuals are kept confidential.
- Merit based pay does not prevent the development of a team spirit and cooperation among workers.

2. The Within Job Variance of Wage Rates and Productivity

Given the well known difficulties of measuring productivity accurately, it would be surprising indeed if relative wages of workers with only a few months or years of tenure at a firm completely reflected their productivity relative to their coworkers in the job. On the other hand, the benefits of merit based pay—greater effort, self selection of more productive workers, and retention of the better performers—are likely to be important enough to require some recognition of relative productivity in wage increase and turnover decisions. Consequently, the empirical work in this and later sections tests two distinct hypotheses regarding the relationships between relative productivity and other outcomes for the occupants of a specific job.

H_1^a = relative productivity has a positive effect on relative wage rates and retention probabilities

versus

H_o^a = relative productivity has no or negative effects on relative wage rates and retention probabilities

H_1^b = the elasticity of relative wage rates with respect to relative productivity is less than one

versus

H_o^b = the elasticity of relative wage rates with respect to realized relative productivity is greater than or equal to one

The primary data set employed is a survey of 659 employers who have provided data on wage rates, reported productivity, training costs, turnover,

and background characteristics of two different new hires for the same job. Most of the respondents were the owner/manager of small firms who were quite familiar with the performance of each of the firm's employees. At larger firms interviews were typically conducted with both the personnel director and a line supervisor. The personnel director provided information on the company and the background of two recently hired employees and the supervisor provided data on the training costs and productivity of the two new employees. The data is described in greater detail in the appendix. The first member of the pair of recently hired employees was obtained by asking the main respondent to select "the last new employee your company hired prior to August 1981 regardless of whether that person is still employed by your company." The second member of the pair was obtained by asking the employer to select "another employee you hired [within the past 2 years] for the same or similar position but with some prior vocational training, the second person selected was not to have had such training. Except for the fact that the two new hires are selected to have different amounts of vocational training, this procedure results in a random selection of two workers hired for the same or a similar job.[9] Seventy percent of these workers were still at the firm at the time of the interview. How much variation is there in wage rates, productivity and training costs between these two new employees? Does the variability of outcomes decrease with tenure? What causes it to decrease?

If hypothesis H_1^a is true we would expect the following:

- o Significant variation in wage rates and productivity both initially and after a year or so at the company
- o As tenure increases the variability of wage rates will rise as employers learn who is more productive and wage rates start to reflect this knowledge
- o As tenure increases there will be a decline in the variability of productivity as the less productive workers are dismissed or quit (because their prospects for promotion and merit increases are poor)

- Workers staying at the firm will have higher productivity than those who quit or are dismissed

The easier it is to accurately measure a worker's productivity, the stronger should be all of the above effects. A major determinant of accuracy of measurement is the size of the establishment. In most jobs merit pay will have to be based on subjective judgments. This is not a severe problem in small firms where the owner is very familiar with each worker's performance. In large establishments merit wage increases must be based on the opinions of line supervisors. Top management often fear that their subordinates will mispreceive the criteria to be used or abuse the power that merit pay gives them.

If a union represents the workers, the ability and inclination of management to adjust wages to productivity is reduced even further. In small owner-managed firms unions are not as much of a threat. The threat of unionization and the difficulty of ensuring that supervisors will carry out instructions correctly is greatest in large organizations, so one would expect a weaker connection between relative productivity and relative wage rates in large establishments than in small establishments. This implies in turn that all of the relationships described in the bullets above should be stronger in small firms than in large firms.

Within job coefficients of variation (CV) for wage rates and productivity have been calculated and tabulated for different sized establishments in table 1.[10] The results provide consistent support for the hypotheses outlined above. Significant wage variation occurs even when the job is held constant. The CV of starting wage rates is 20 percent in small firms and 10 percent at

TABLE 1

WAGE AND PRODUCTIVITY VARIATION
BY SIZE OF ESTABLISHMENT
(Within Job Coefficients of Variation)

	200+	50-200	10-49	1-9
Both Stayers and Leavers				
Starting wage	10%	15	20	20
Productivity week 1-2	23	36	42	50
Productivity week 3-12	16	25	31	39
Productivity net of training cost	63	56	69	125
Current wage	14	19	28	22
Current productivity	22	24	33	42
SD of training investment[1]	17	30	30	31
Stayers Only				
Current wage	14	21	21	24
Current productivity	19	18	18	19
Increase in productivity due to selective attrition[2]	6.8%	5.0%	6.3	11.9

[1]Training investment during the first 3 months is measured relative to the productivity for that 3-month period of trained workers with 2 years of tenure at the firm.

[2]The effect of selective attrition is calculated by dividing the average current productivity of stayers by the average productivity of both the stayers (current) and leavers (a week before leaving) together.

establishments with more than 200 employees (row 1).[11] As the firm learns more about its employees the CV of wage rates increases (compare with row 5 and 8).

In the first months on the job the CV of productivity is considerably higher than the CV of wage rates. There is also a great deal of worker variation in training costs. Training costs were measured relative to average productivity of coworkers with 2 years of tenure at the firm. At establishments with fewer than 200 employees the standard deviation of training costs during the first 3 months on the job is 30 percent of a coworker's output for that period. When training costs are subtracted from the worker's production during the first 3 months, the coefficients of variation become quite large--between 50 to 70 percent for firm's with more than 10 employees and 125 percent for very small firms.

Productivity variations across workers do not remain at this magnitude for two reasons. First, the average monthly costs of training diminish with tenure. This lowers the CVs of productivity net of training costs because the mean of productivity net of training costs increases and the variation of training costs diminishes. The second reason for the reduction in within job productivity variation is selective attrition. A comparison of the productivity CV for stayers only (row 9) with the CV of stayers and leavers combined (row 6) makes this apparent. Removing from the sample pairs in which one member leaves the firm before the interview greatly reduces within job differences in worker productivity especially in the smaller establishments. The resulting estimate of the CV for job incumbents (.18-.19), is remarkably close to the estimate Schmidt and Hunter (1983) derive in their recent review of the industrial psychology literature.

Less productive workers are more likely to leave, so the long term employees are typically more productive than the new hires simply because of selective attrition. The impact of selective attrition was calculated by dividing the mean reported productivity at the time of the interview for stayers by the mean reported productivity for stayers and leavers (a week before leaving). At establishments with fewer than 10 employees attrition is apparently both considerable and highly selective and it results in a productivity gain of 12 percent. At larger establishments the impact of selective attrition is a 5 to 7 percent increase in average productivity. Note that after only one or two years of selective attrition large and small establishments have almost equal CVs of current productivity. Apparently large firms are more careful and selective in their hiring so selective attrition has less work to do. The workers hired by small firms are more uneven in quality. They are given a tryout and those who do not make the grade are washed out. At this point, however, some of these comments are speculative for the connection between relative productivity and relative wages and turnover has not been established. It is to this task we now turn.

3. The Effect of Relative Productivity on Relative Wage Rates: Empirical Findings

To what extent are differentials in productivity (relative to one's coworkers) incorporated into relative wage rates? The BLS periodically asks employers to describe the method they employ in setting wages. Table 2 presents the results of BLS surveys between 1968 and 1970 of firms with more than 50 employees. More than half of the plant workers had their wages set by a system which took no account of differences in productivity. The other 86 percent either had their pay set individually or were on a range of rates system in which wage increase were based fully or partially on merit (Cox 1971). These surveys, however, provide no measure of the magnitude of the wage rate or turnover response to merit and also lack coverage of people working in smaller establishments.

The NCRVE Employer Survey provides a unique data set for examining the determinants of and the parameters of merit based pay. It provides retrospectively longitudinal data on the wage rates, turnover and reported productivity of a pair of new hires for the same (or a similar) job. Small establishments are well represented in the sample.

The econometric framework for examining the extent to which wages reflect actual differences in productivity will now be presented. We assume that the "i"th workers' wage relative to the mean for the job is described by the following equation:

$$(1)\quad W_{ij} = b_1(P_{ij}-P_j) + b_2(T_{ij}-T_j) + B(X_{ij}-X_j) + u_{ij}$$

where

$W_{ij}-W_j$ = the deviation of the individual wage from the mean.

TABLE 2

METHOD OF WAGE DETRMINATION IN
ESTABLISHMENTS WITH 50+ EMPLOYEES

	Plant Workers	Office Workers
Everyone paid same rate	36%	3
Range with progression based on		
Seniority	16	11
Merit	9	36
Both merit & seniority	12	22
Pay set individually	13	28
Individual incentive	10	0
Group incentive	4	0
	100	100

Source: BLS area wage surveys in 85 urban area between 1968 and 1970 (Cox, 1971)

$P_{ij}-P_j$ = the deviation of the individual's productivity from the mean.

$T_{ij}-T_j$ = the difference between the training required by the individual and that required by the typical worker.

$X_{ij}-X_j$ = a vector of differences in tenure, credentials and background characteristics between the individual and the mean for occupants of the job.

u_{ij} = individual specific error term.

Data are not available on the means (W, P, T and X) so equation 1 cannot be estimated. For many firms, however, there is data on two workers doing the same job so the following equation for the difference between the wage rates of person 1 and 2 can be estimated:

(2) $W_{1j}-W_{2j} = b_1(P_{1j}-P_{2j}) + b_2(T_{1j}-T_{2j}) + B(X_{1j}-X_{2j}) + u_{1j-u2j}$

If there is a feedback from realized productivity and training to wage rates, we expect the coefficients on productivity and training to be significantly different from zero. Specifically, if H_1^a is true we expect the coefficient for productivity to be positive and the coefficient for training to be negative. Our second hypothesis, H_1^b, is that firms only partially adjust their wage rate to observed productivity and training investment. If this hypothesis is true, b_1, will be less than 1. The hypothesis that the size, unionization and the firm specificity of skills influence the prevalence and parameters of merit based pay plans is tested by interacting these establishments characteristics with P_1-P_2 and T_1-T_2.

Two equations for wage rates, one for the logarithm of the starting wage rate and the other for the logarithm of the latest wage rate were estimated. For most of the workers who were still at the firm, the latest wage is the wage rate at the time of the interview which is generally about a year after they were hired. For the workers who had separated, the latest wage rate was

the wage immediately preceding the separation. The sample was limited to pairs of individuals both of whom had stayed at the firm at least 3 months. The appendix to the paper describes the data set employed in the analysis and the method by which training investment and reported productivity were measured.

A simple model relating relative wages to relative productivity and relative training time but not to background characteristics of the worker is presented in Table 3. The starting wage is set before the new hire starts work, so one would not expect productivity realizations to have as strong an effect on starting wages as on current wages. This expectation is confirmed for the elasticity of starting wage rates with respect to productivity is only .08 while the elasticity of latest wage rates with respect to productivity is .25 (when tenure is not controlled).[12]

Employers seem to be able to anticipate when a new hire will require extra training, and to offer lower wage rates to new hires who require the extra training. The response of the wage to training costs is small, however. A 100 hour increase in training during the first 3 months--the cost of which is--equivalent of one fifth of a new employee's potential productivity--reduces the new hire's starting and latest wages by only 3.4 percent. The small size of this response suggests that most of the training in the first 3 months is functionally specific to the firm and/or that employers find it difficult to anticipate how much additional training an inexperienced worker is going to require.

The finding that the elasticity of relative wage rates with respect to relative productivity is significantly below 1 implies that wages for workers who have been at a firm for about a year only partially reflect person-to-person variations in reported productivity on the job. The person who provided

TABLE 3

IMPACT OF WORKER PRODUCTIVITY ON WAGE RATES

	Starting Hourly Wage		Current Hourly Wage			
Training Time (100's of hours)	-.033***	(3.09)	-.031**	(2.15)	-.033**	(2.39)
Productivity						
2d week	.146**	(2.48)	.091	(1.17)	.102	(1.32)
3-12 week	.026	(.32)	-.015	(.14)	-.011	(.10)
At interview or separation	-.010	(.22)	.270***	(4.72)	.215***	(3.69)
Tenure (yrs)	---		---		.051***	(2.74)
Tenure^2	---		---		-.0022	(.74)
Hours worked/week	.0006	(.45)	.0052***	(2.92)	.0042**	(2.39)
Temporary employee	-.030	(1.18)	-.148***	(4.43)	-.139***	(4.20)
Student	.009	(.38)	.062*	(1.91)	.048	(1.51)
Year of hire	.044***	(6.26)	---		---	
Year of hire^2	.0020***	(2.72)	---		---	
Number of Observations	470		470		470	
R Square	.173		.209		.238	

NOTE: This table is based on fixed effects models that compare two new hires for the same or a similar job at a firm.

* significant at the 10 percent level (two-sided)
** significant at the 5 percent level (two-sided)
*** significant at the 1 percent level (two-sided)

these productivity reports was, in most cases, the owner or manager of a small establishment (70 percent had fewer than 50 employees) and was thus quite frequently the person who decides on the wage offer for each individual. The regression is therefore capturing the relationship between the productivity of individual workers as perceived by the person setting wages and the wage rate that is offered and agreed to.

What do these results imply about the elasticity of relative wage rates with respect to true productivity? If relative wage rates are set on the basis of perceived relative productivity and not true relative productivity, and the elasticity of perceived relative productivity with respect to true relative productivity is less then one, then .25 is an upper bound of the magnitude of the short run within job elasticity of the wage rate with respect to true productivity. This finding helps explain why studies that have absolute measures of worker productivity typically find that coefficients of variation for productivity greatly exceed the coefficient of variation of wage rates. Bobko, Karren, and Parkington's (1983) study of 92 insurance counselors found, for instance, that coefficients of variation were 42 percent for the sales of these counselors but only 14.6 percent for their earnings.

In the absence of good direct measures of worker productivity, the employer will probably use background characteristics as signals for predicting the productivity of new employees. As the firm learns more about a worker we would expect wage decisions to depend more on observed productivity and less on background characteristics. Background characteristics should continue to have some role in determining wage rates, however, because (1) background traits influence a worker's marketability at other firms regardless of their productivity in their current job and (2) errors in measuring productivity

leave a role for other variables which are correlated with true productivity. Many of the signals normally available to hiring decision makers--age, sex, education, previous relevant work experience--are also included in our data. It was, therefore, possible to test these hypotheses by modeling differentials in starting and latest wage rates as a function of differentials in both the signals of productivity and the measures of actual productivity. The results of this exercise are presented in table 4.

The worker's background characteristics have large and significant impacts on both starting and latest relative wage rates even when observed productivity is controlled. Traits that signal general human capital such as total experience and years of schooling have roughly equal impacts on both initial and later wage rates. Holding work experience in a relevant job constant, an additional 5 years of total experience raises both starting and later wage rates by 3.3-3.5 percent and an additional year of schooling raises relative wage rates by 1.1-1.2 percent.

Traits which signal occupation or industry specific human capital tend to have a smaller impact on later wage rates than on starting wage rates. Holding realized productivity and total experience constant, 5 years of relevant work experience raise wage rates by 7 percent at the start but by only 4 percent at the time of the interview. Being a referral from a union has an extremely large effect on starting wages but a much smaller effect on current wages. Including background characteristics in the model raises the R^2 of the starting wage model from .173 to .360. For the latest wage the increment to R^2 is smaller, from .209 to .302. The greater importance of background characteristics in the starting wage model suggests that the value of these

TABLE 4

IMPACT OF WORKER PRODUCTIVITY ON WAGE RATES

	Starting Wage		Latest Wage	
Training Time (100's of hours)	-.020**	(1.99)	-.024	(1.41)
Productivity				
2nd week	.090	(1.47)	.052	(.60)
3rd-12th week	-.006	(.10)	-.008	(.08)
At interview or separation	-.011	(.26)	.211***	(3.56)
Relevant Experience	.0155***	(4.54)	.0093*	(1.94)
Relevant Experience^2 (divided by 100)	-.028***	(2.26)	-.027	(1.55)
Total Experience	.0080***	(4.10)	.0074***	(2.68)
Total Experience^2 (divided by 100)	-.020***	(3.61)	-.0141*	(1.81)
Years of Schooling	.011***	(2.87)	.012**	(2.23)
Relevant Vocational Education	.040***	(3.39)	.031*	(1.87)
Private Vocational Education	.006	(.24)	.026	(.67)
Female	-.039*	(1.85)	-.026	(.87)
Known to Be TJTC Eligible	-.062	(1.66)	-.164***	(3.09)
Union Referral	.430***	(4.78)	.125	(.98)
Number of Observations	456		456	
R Squared	.360		.302	

NOTE: This table is based on fixed effects models that compare two new hires for the same or a similar job at a firm. Other variables in the model were whether the job was temporary, whether the individual was a student, hours worked per week, whether referred by a relative, and whether subsidized by a program other than TJTC. The model for latest wage also contained tenure and tenure squared. The model for starting wage contained date of hire and the date of hire squared.

* significant at the 10 percent level (two-sided)
** significant at the 5 percent level (two-sided)
*** significant at the 1 percent level (two-sided)

signals (as predictors of productivity) diminishes as the firm learns more about its new employee.

What is the unique effect of observed productivity when background characteristics are controlled? The results suggest that when background is controlled, realized productivity has almost no effect on the starting wage but large and significant effects on wage rates after a year or so at the firm.

In the starting wage model none of the coefficients on realized productivity variables are statistically significant and the implied elasticity is only .03. In the latest wage model, the effect of current productivity is large and statistically significant. The elasticity of wage rates with respect to productivity is .19, only marginally below the .25 of the simple model that excludes background characteristics. This means that while starting wages are based on background characteristics and credentials, later wage rates increasingly depend on actual job performance. Workers are rewarded for doing a better than average job.

The conclusion that relative wage rates at interview or separation depend on realized productivity as well as worker characteristics is subject to challenge, however, if employers set wage rates on the basis of worker characteristics such as recommendations from previous employers and aptitude test scores that are not available to the researcher. If such information is available to the employer and it has a continuing effect on wages even after the new hire has been at the firm for a year, the productivity measures will tend to pick up the effects of these omitted worker characteristics and the coefficients on current and lagged productivity will have a positive bias. We examined the presence of omitted variables in wage equations by jointly estimating the starting and latest wage equations using a seemingly unrelated

regression technique. Evidence that some of the determinants of relative wage rates are not included in our models is provided by the fact that there is a positive correlation of 0.4 between the errors of the 2 equations. Any possible bias produced by an omitted characteristic, however, seems to be very small. For the latest wage, it is only the contemporaneously measured productivity variable that has a large positive effect on the wage, and actual productivity in the first 2 weeks and the next 10 weeks show no significant impact. Also, in the starting wage model, it is actual productivity in the first 2 weeks that has the largest positive effect and current productivity has a tiny nonsignificant negative effect. This pattern of coefficients suggests that (1) omitted worker characteristics are not a significant source of bias for the coefficients on the productivity variables in the model of the latest wage and (2) wages adapt quickly though not completely to the realized productivity of the new worker.

One would not expect all firms to be equally able or inclined to adjust relative wage rates to the realized relative productivity of workers. Small establishments and non-union establishments are expected to be more likely to base wage increases on a worker's productivity. Large establishments are less likely to use merit pay because productivity is more difficult to measure and skills are more specific than at small establishments. The greater specificity of skills arises partly from greater specialization of function and partly from the fact that large establishments face fewer competitors for labor. The effective specificity of skills also depends on the size of the local labor market. In a small labor market workers have a more limited range of choices so quits are not likely to be as responsive to relative wage rates as in large labor markets. Where quits are very responsive to the individual's wage,

employers are induced to pay higher wage rates to their more productive employees.

These hypotheses were tested by interacting current productivity with unionization, establishment size and labor market size in models of the latest relative wage (see table 5). The coefficients on the size and unionization interactions were negative as anticipated, and the coefficient on the size/productivity interaction was significantly negative. At non-union establishments with 17 employees, the elasticity of the wage with respect to productivity is 0.2. Though the coefficient on the unionization interaction is not statistically significant, it's point estimate implies that a unionized firm of that size would have a wage elasticity with respect to productivity of 0.10. The results imply that the elasticity of the relative wage with respect to relative productivity will be 0.09 at a non-union establishment with 100 employees, -0.01 at a unionized establishment with 100 employees, and zero at a non-union establishment with 400 employees. Clearly the relative wage rates of different workers in the same job do not vary proportionately with their productivity. In medium-sized unionized establishments, and large non-union establishments, there does not seem to be any immediate response of relative wages to reported relative productivity. Such establishments are underrepresented in this data set, so the mean elasticity of .19 derived from this sample exaggerates the true average response of relative wage rates to reported relative productivity.

The labor market size interactions with productivity and training have the expected sign in both the starting and latest wage models. The training interaction is statistically significant in both models. Differentials in training costs have no effect on starting wage differentials in labor markets

TABLE 5

IMPACT OF WORKER PRODUCTIVITY ON WAGE RATES:
INTERACTIONS WITH
UNIONIZATION, ESTABLISHMENT AND LABOR MARKET SIZE

	Starting Wage		Latest Wage	
Training Time (100's of hrs.)	-.026**	(2.58)	-.023	(1.62)
Productivity First 2 Weeks	.071*	(1.64)	.062	(.95)
Productivity (most recent)	--	--	.216***	(4.66)
Size Times Productivity	.003	(.11)	-.079**	(2.56)
Union Times Productivity	.203	(1.27)	-.123	(.56)
Labor Market Size Times Productivity	.014	(.48)	.100***	(3.49)
Labor Market Size Times Training	-.018**	(2.11)	-.025**	(2.26)
Union Referral	.404***	(4.37)	.139	(1.11)
Relevant Experience	.0154***	(4.51)	.0102**	(2.16)
Relevant Experience Sq. (divided by 100)	-.027***	(2.16)	-.026	(1.51)
Total Experience	.0074***	(3.75)	.0068**	(2.49)
Total Experience Sq. (divided by 100)	-.018***	(3.28)	-.013**	(1.66)
Years of Schooling	.010***	(2.67)	.010**	(1.83)
Relevant Vocational Education	.043***	(3.63)	.032*	(1.95)
Private Vocational Education	.005	(.18)	.027	(.74)
Female	-.041*	(1.96)	-.031	(1.06)
Known to be TJTC Eligible	-.067*	(1.78)	-.161***	(3.08)
Received JTPA Subsidy	.010	(.27)	.002	(.04)

NOTE: This table is based on fixed effects models that compare two new hires for the same or a similar job a firm. Models were estimated using seemingly unrelated regression. Other variables in the model were whether the job was temporary, whether the individual was a student, and hours worked per week. The model for the latest wage also contained tenure and tenure squared. The model for starting wage contained date of hire and the date of hire squared. The weighted R square for the system was 0.348, and the correlation between the residuals of the 2 equations was 0.40. In the starting wage model, size and unionization are interacted with productivity in the second week. In the latest wage model interactions are with most recent productivity.

* significant at the 10% level (two-sided)
** significant at the 5% level (two-sided)
*** significant at the 1% level (two-sided)

that are 1/4 the sample median. A 100-hour increase in training costs lowers a worker's starting wage rate by 2.6 percent in labor markets of median size and lowers the starting wage rate by 5 percent in labor markets of 4 times median size. Labor market size has a significant positive effect on the responsiveness of wages to productivity. The elasticity of latest wages with respect to productivity is .09 in labor markets that are 1/4 the sample median in size and .31 in labor markets of 4 times median size.

4. The Effect of Training and Productivity Growth on Turnover

What impact does the productivity of a worker and the training received by that worker have on turnover? The findings in the previous section support a view that wage rates and other job rewards are often tied to the job occupied and respond to the perceived competence of individual workers only incompletely. Another way employers may respond to productivity differentials between workers is by promoting the most productive and firing the least productive. Many employment contacts (both explicit and implicit) limit the firm's flexibility in setting wage rates but offer it great flexibility in releasing unproductive new hires during a probationary period that may last as long as 6 months. One reason why firms fire less-productive workers rather than offering them a lower wage is that it can be very costly to individually negotiate wages each year. As a worker gains tenure on the job, the specificity of the job match increases. Renegotiating wage rates after specific training is completed will be very costly because the gap between the threat points of each party can be quite large and the incentives for strategic behavior are strong (Hashimoto and Yu 1981).

A second reason for such contracts might be morale considerations. Retaining an unproductive worker who has been chastened by receiving a salary cut or demotion may be bad for morale. The bitterness that such an event causes may result in grievances being filed against the company, efforts to organize the firm's employees, further declines in the worker's productivity, damage to the morale and cohesiveness of the work group, and sabotage (Akerlof 1982).

In this subsection, we examine the impact of differentials in realized productivity on the differentials in turnover of people occupying the same job. How responsive is turnover to such differentials? At which types of firms is turnover most responsive to productivity and training differentials? Have the firms that do not adjust wages to productivity differences compensated for this by being quicker to fire the workers who are less productive? Does Fama's (1980) observation regarding managers "When the firm's reward system is not responsive to performance . . . the best are the first to leave" (p. 292) apply to other occupations? These issues will be examined in the context of models of the turnover of a sample of workers who had been recruited for permanent jobs and who stayed at the firm at least 3 months. The effects of the firm's characteristics on the average level of turnover was partialed out by examining differences in subsequent turnover between pairs of workers who had the same job and met the selection criteria noted here. Limiting the sample to those who stayed at the firm at least 3 months means that we have one measure of training investment and two measures of reported productivity that are not contaminated by turnover events. The models therefore characterize the effect of the training provided in the first 3 months and the productivity achieved during that period on subsequent turnover.

Models like equation 2 were estimated predicting differences in the log of actual tenure and probabilities of voluntary and involuntary separations. The results of the analysis are presented in table 6. When measures of actual training and productivity were included in the models, almost none of the characteristics of the worker were statistically significant. The sole exception to this was that people recruited through news-

TABLE 6

IMPACT OF TRAINING AND PRODUCTIVITY ON TURNOVER
(within firm models)

Explanatory Variables	Log Tenure		Involuntary Separation		Quit	
Training Intensity (100's hrs)	.021	.045	-.071**	-.078***	.052	.047
	(.5)	(1.2)	(2.5)	(3.0)	(1.5)	(1.4)
Productivity 2d Week	-.763***	- 640**	-.200	-.198	.262	.227
	(3.0)	(2.5)	(1.1)	(1.2)	(1.2)	(1.1)
Productivity 3d-12th Week	2.186***	2.153***	-.516***	-.757***	-.591**	-.452**
	(7.0)	(8.5)	(2.5)	(4.6)	(2.3)	(2.3)
Productivity 3d-12th Week Times Size	-.293**	-.286**	-.119	-.167**	.166*	.213**
	(2.5)	(2.4)	(1.5)	(2.1)	(1.7)	(2.1)
Productivity 3d-12th Week Times Union	-.154	-.021	.854	.707	.528	.341
	(.2)	(.6)	(1.6)	(1.5)	(.8)	(.6)
Productivity Times White Collar	-.101		-.646***		.430	
	(.3)		(3.0)		(1.56)	
Productivity 3d-12th Wk Times Lbr Mkt		.049		.217***		-.247
		(.41)		(2.8)		(2.5)**
Log Starting Wage	-.056		.148		-.065	
	(.3)		(1.2)		(.4)	
Number of Observations	468	514	468	514	468	514
R Squared	.604	.587	.215	.203	.118	.115

NOTE: These models of differences between the tenure and turnover of two workers in the same job have th following control variables: dummies for referral source, relevant experience and total experience and their squares, log of potential tenure and its square, years of schooling, gender, relevent vocational education, private vocational education, known to be TJTC eligible when hired, subsidized by JTPA, hours worked per week, and working at the firm while part of a co-op program.

* significant at the 10% level (two-sided)
*** significant at the 5% level (two-sided)
significant at the 1% level (two-sided)

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paper ads were more likely to be fired and had shorter tenure, school referrals had lower dismissal rates, employer referrals had higher dismissal rates, and women had lower quit rates. By far the most powerful determinant of turnover is reported productivity during the 3d-12th week of employment. When the productivity scale is defined over a range from 0 to 1, workers' productivity in the 3d-12th week has a mean of 0.65 and standard deviation of 0.14. Holding labor market size constant, a 1 standard deviation (0.14) rise in the productivity report raises expected tenure by 30 percent at a non-union company with 17 employees. It lowers the probability of being fired by 11 percentage points and the probability of quitting by 6 percentage points. If productivity is 0.14 higher both initially and during week 3-12, expected tenure is 22 percent greater, the probability of being fired is 13 percentage points lower, and the probability of quitting is 3 percentage points lower. Less productive workers are more likely to quit, but is in the probability of being fired or laid off where productivity has a really big affect.

Wage rates were found earlier to be less responsive to productivity in large establishments and in small labor markets. This should result in quits becoming less responsive to productivity and dismissals becoming more responsive to productivity at these firms. These hypotheses are supported by the results reported in column 4 and 6 of table 6. The impact of a one standard deviation increase in productivity on the probability of dismissal is -.16 at establishments with 200 employees and -.09 at establishments with 10 employees. The response of the quit rate is +.01 at establishments with 200 employees and -.08 at establishments with 10 employees. For firms with 19 employees a one standard deviation increase in productivity in the

3-12th week changes the dismissal probability by -.06 in labor markets of 4 times median size and by -.15 in labor markets of one fourth the median size. The response of the quit rate is -.11 for labor markets of 4 times median size and -.015 in labor markets of one fourth median size. As labor market size increases, the increasing sensitivity of quits to productivity tends to offset the declining sensitivity of dismissals to productivity. The result is that tenure's response to productivity does not change with labor market size. The offset is not complete for variations in establishment size, however. Tenure is less responsive to a worker's productivity at large establishments than at small establishments. A 1 standard deviation (0.14) increase in both productivity reports increases expected tenure by 30 percent at non-union companies with 17 employees and by 21 percent at non-union companies with 200 employees.

Unionization apparently effects the response of turnover to productivity very differently than firm size. While the interaction coefficients are not statistically significant, their point estimates imply that the dismissal and layoff probabilities of unionized workers who have 3 or more months of tenure do not depend upon the worker's actual productivity. Union contracts apparently lower the sensitivity of both wage rates and dismissals to job performance.

The primary prediction of human capital theory about job turnover is that workers who have a great deal of specific training should have lower rates of turnover. This proposition applies to workers who have completed their training or whose training is well underway. If the employer has paid for most of the costs of specific training, a significant loss is suffered if a separation occurs, so we would expect the separations over

which the employer has control (involuntary separations) to be negatively related to the amount of specific training. If the employee has paid for the specific training, one would expect voluntary separations but not involuntary separations to be negatively related to the amount of specific training provided.

Expected tenure is greater for workers who have received more than the normal amount of training, but the coefficients are not statistically significant. More intensive training raises expected tenure by lowering rates of involuntary termination. Holding productivity constant, a 100 hour increase in training investment during the first 3 months lowers the probability of being fired in the subsequent period by 7-8 percentage points. Receiving greater than normal amounts of training does not seem to reduce quit rates. The fact that additional investments in training reduce involuntary turnover but not voluntary turnover supports previous findings that most of the training provided in the first months on a job is functionally specific to the firm (Bishop 1986). Apparently some new hires are recruited for their potential not their experience and for those new hires the receipt of extra training may reflect a belief in the worker's potential.

5. Training, Productivity and the Incidence of Promotions

About one-third of our sample of new hires were promoted before the date of our interview. Consequently, an analysis of promotions was conducted which paralleled the analysis of turnover. The results of this analysis of differences in promotion likelihoods of two recent new hires is presented in table 7. As one might anticipate, productivity during the 3d-12th weeks on the job was by far the single most important determinant of an individual's likelihood of promotion. Those who were 15 percent (0.10) more productive than other new hires in that job were 13 percentage points more likely to be promoted.

The coefficients on reported initial productivity are negative but not statistically significant. This implies that low productivity in the initial weeks on a job is not held against a new employee being considered for promotion if learning is rapid and very high levels of productivity are attained. The size of the firm has no effect on how sensitive promotion decisions are to perceptions that a worker is highly productive. There does seem to be a tendency, however, for unionized firms to be considerably less affected by productivity when deciding about promotions than non-union firms.

There is a clear tendency for those who receive more intensive training in the first 3 months on a job to have a higher probability of subsequently being awarded a promotion. A doubling of training intensity during the first 3 months is associated with a 7 percentage point higher probability of promotion at companies with 17 employees. This association is even stronger at large establishments. If the company has 200 employees, a doubling of the training intensity in the first three months is associated with a 22 percentage point higher probability of being promoted.

TABLE 8

IMPACT OF TRAINING AND PRODUCTIVITY
ON PROMOTIONS
WITHIN FIRM MODEL

Explanatory Variables	Model 1	Model 2
Log Training	.087*	.105**
	(1.8)	(2.0)
Log Training Times Size	.089**	.090**
	(2.6)	(2.0)
Productivity 2d Week	-.282	-.199
	(1.3)	(.9)
Productivity 3d-12th Week	1.332***	1.276***
	(6.4)	(5.8)
Productivity Times Size	.087	.098
	(.8)	(.9)
Productivity Times Union		-.957
		(1.5)
Log Starting Wage	-.261*	-.281*
	(1.8)	(1.7)
R Squared	.216	.256

NOTE: Model 1 contains only three additional variables: hours worked, log potential tenure, and log potential tenure squared. Model 2 contains the following additional characteristics of the worker: gender, relevant experience, total experience, referral source dummies, years of schooling, relevant vocational education, private vocational education, known to have been a TJTC eligible when hired, subsidized by JTPA, and initially hired as a co-op student. Only the co-op student variable had a statistically significant effect (+) on promotions.

* significant at the 10% level (two-sided)
** significant at the 5% level (two-sided)
*** significnat at the 1% level (two-sided)

6. Summary

Important differentials between firms have been found in the prevalence and power of merit based pay. While a worker's reported productivity relative to peers does have important and reasonably rapid effects on relative wage rates at small and medium sized non-union establishments, it has almost no effect at unionized establishments with more than 100 employees and at non-union establishments with more than 400 employees. One of the important outcomes of merit based pay is its impact on quit rates. The workers who received small or no wage increases are often induced to quit. As a result, at the small non-union establishments it is definitely not the case that the best employees quit. The reverse is in fact the case. At unionized plants and large non-union establishments, however, the least productive workers are not more likely to quit. Since dismissals are initiated by the employer, they follow a different pattern. Union contracts make it very costly to dismiss a worker who has survived the probationary period, so in these firms there is apparently no tendency for poor job performance to raise the probability of an involuntary termination. The types of firms where dismissals are most contingent on the worker's performance are the large non-union firms.

These results are consistent with a segmented market/efficiency wage view of the world (Bulow and Summers 1985). Apparently at the small establishments monitoring costs are low, effort and productivity are rewarded by higher wage rates and low productivity results in an increased likelihood of a quit or dismissal. At unionized establishments neither the wage nor turnover depends on performance. At large non-union establishments wages do not quickly respond to productivity (and as a result quits are not negatively associated with productivity as they are in small non-union establishments) but dismissals are

very responsive to reported productivity. Apparently, the implicit contracts which tend to predominate in large non-union firms prespecify future relative wages but hold open a threat of a dismissal if productivity is too low. Where monitoring of performance is costly and necessarily espisodic, discipline must be maintained by the threat of a dismissal and this may force the firm to pay a wage rate that is above the market clearing wage.

The other major contribution of the paper is the finding that there are large differences in productivity between workers doing the same job and that relative wage rates respond positively but incompletely to these differentials. A recent review (Schmidt and Hunter 1983) of studies that contained direct measures of output for different workers doing the same job at the same firm found that the coefficient of variation of worker productivity while highly variable across jobs has a mean of about 20 percent for jobs paid on an hourly or salaried basis. Our estimates of the CV of job incumbants was .18 to .19. Since there are fixed costs to employing an individual (facilities, equipment, light, heat, and overhead functions such as hiring and payrolling), the coefficient of variation of net marginal product is likely to be even greater (Klein, Spady and Weiss 1983; Boudreau 1983).

The paper presents evidence that wage rate differentials between workers with about one year of tenure only partially reflect current and past differentials in productivity and that there is essentially no immediate response of relative wage rates to productivity in very large establishments. Whether compensation for greater productivity comes over a longer time frame or in other ways cannot be tested in this data. Clearly this is an issue that needs to be studied for it is important to know whether workers are in the long run fully compensated for the increases in productivity that result from extra

effort or improved skills. The inevitability of significant errors in measuring productivity (that cannot be eliminated by measuring it repeatedly) and the functional specificity of many productivity differentials creates a strong a priori case (see section 1) that compensation for greater productivity is often only partial. Clearly there is a need for additional theoretical and empirical work addressing (1) the determinants of and the parameters of merit based compensation, and (2) the impact of job performance and skills developed in one job on subsequent turnover, the length of unemployment spells and compensation in later jobs.

FOOTNOTES

1. The work sample measure of job performance is certain to have some errors in measurement so the true r_{ot} is greater than .42.

2. Assume $p^o = p^t+u$, $cov(p^t,u) = 0$ and $r_{ot} = .42$, then

$$cov(p^t,p^o) = Var(p^t) \text{ and } (r_{ot})^2 = \frac{cov(p^t,p^o)^2}{Var(p^t)\,Var(p^o)} = \frac{Var(p^t)}{Var(p^o)} = .176$$

When $p^t = \hat{\beta}p^o$ is estimated, $\hat{\beta} = \frac{Var(p^t)}{Var(p^o)} = .176$.

3. In the employer survey used in the empirical work that follows, the coefficient of variation of the supervisor reports of productivity for job incumbants is smaller than direct measures of coefficients of variation (for jobs not paid on a piece rate) from data sets which measure productivity on a ratio scale.

4. Assume $p^o = p^t+u$, $u = -(1-\alpha)p^t+v$, $Var(p^o) = Var(p^t)$

$cov(p^t,v) = 0$ and $r_{ot} = .42$. Then $cov(p^t,p^o) = \alpha\, Var(p^t)$ and

$$(r_{ot})^2 = \frac{cov(p^t,p^o)^2}{Var(p^t)\,Var(p^o)} = \frac{\alpha^2 Var(p^t)^2}{Var(p^t)^2} = .176 \text{ so } \alpha = .42.$$

When $p^t = \hat{\beta}p^o$ is estimated, $\hat{\beta} = \alpha \frac{Var(p^t)}{Var(p^o)} = \alpha = .42$

5. Keeping information about past performance confidential lowers the quality of matches between workers and jobs and raises turnover and thus lowers productivity and wage rates. Despite this there are no great opportunities to profit by going into the business of offering "reliable" recommendations because workers are risk averse and because it is very difficult and costly to establish a reputation for providing "reliable" recommendations. Past experience with previous referrals is the way a reputation for providing "reliable" recommendations is developed but most employers do not hire numerous workers away from the same previous employer so there is little opportunity for such reputations to develop. Since recommendations are provided by supervisors it is really the supervisor who would have to develop the reputation for reliability. This lowers even further the probability that a reputation as "reliabile" reference can be developed.

6. Evidence that firms care a great deal more about productivity losses arising from lack of effort than they care about equivalent losses arising from ability or skill deficits is not hard to find. A recent survey (Miguel and Foulk, 1984) asked 150 supervisors to describe how they would handle various violations of job expectations. The response categories supplied to them were

ignore, discuss if persists, discuss immediately, warning, suspend, and fire immediately. These response categories were assigned numerical values from zero for ignore to five for fire immediately. The typical reaction to a worker who "tries but is 15 percent less productive than other workers with the same training" (1.73) and to a worker who "seems not to be trying but is no less productive than other workers" (1.53) tended to be to discuss it with the worker either immediately or if it persists. A worker who "doesn't try and is 15 percent less productive than others with the same training" was typically in much more serious trouble. Their mean score was 3.07 implying that they would immediately be given a warning and would be fired if it persisted.

7. Announcing the outcomes of performance appraisals and merit increases would seem to be a costless way to increase the reward for greater effort (relative status effects would be accentuated). The fact that this seldom occurs, implies that it is generally not in the joint interest of workers and the firm to increase the salience of relative status. This suggests that competition for relative status may be a negative sum game not a zero sum game. It may militate against the team spirit and cooperation which are crucial to an organizations effectiveness.

8. One place where this phenomenon operates is academic departments that are striving for distinction. Frank (1984) has attributed the flat salary structure of academic departments to the drive for relative status within the department. But this implies that the average quality of one's colleagues is a negative characteristic of the job. A better explanation of the flat salary structure of academic departments is that it reflects the flat salary structure of the profession. Since a top contribution or important discovery yields honor and respect as well as higher pay, the pecuniary rewards necessary to motivate effort are not as great as they would have to be if respect were not contingent on research achievements.

9. Differences in vocational training account for very little of the differences in wage rates productivity and training costs, so the requirement that the two workers have different amounts of vocational training has only a minor effect on estimates of the variance of worker productivity and training costs.

10. The within job coefficient of variation was calculated as follows:

for wage rates it was $\frac{1}{N}\sum_{-}(w_{1j}-w_{2j})^2$ where w_{ij} is the log of the wage paid the "i"th person in job j and N is the number of observations. For productivity the CV = $(\frac{1}{N}\sum(P_{1j}-P_{2j})^2)/\bar{P}_j$ where P_{ij} is the reported productivity on a 0-100 scale and $\bar{P}_j$ is arithmetic mean of productivity reports. See the Appendix for a full description of the productivity and training variables.

11. The date of hire of course affects the starting wage rate. In order to limit this source of variation, starting wage rate comparisons were only made between individuals who were hired after January 1980 and before September 1981.

12. The elasticities were calculated by assuming a 1 percent increase (at the mean) in each of the three productivity reports.

APPENDIX ON DATA AND MEASUREMENT ISSUES

This paper is based on data from a survey of 3,412 employers sponsored by the National Institute on Education (NIE) and the National Center for Research in Vocational Education (NCRVE) conducted between February and June 1982. The survey represented the second wave of a two-wave longitudinal survey of employers from selected geographic areas across the country.

The first wave was funded by the U.S. Department of Labor to collect data on area labor market effects of its Employment Opportunity Project (EOPP). The survey encompassed 10 EOPP pilot sites and 18 comparison sites selected for their similarity to the pilot site. The survey design specified a strategy of oversampling firms with a relatively high proportion of low-wage workers.

The second wave attempted to interview all of the respondents in the first-wave survey. About 70 percent of the original respondents completed surveys for the second wave. The data collected by this second survey on the training received by particular workers and their reported productivity are more extensive than those available in the first wave (or in any other data set known to the authors).

In the bulk of the sample, respondents were the owners/managers of the establishments. In large organizations, the primary respondent was the person in charge of hiring, generally the personnel officer. When primary respondents were unable to answer a question, they were asked if someone else in the organization would have the information, and that part of the interview was completed with this other official. Other respondents included comptrollers, wage and salary administrators, and line supervisors (for questions about a particular recent hire). Most of the respondents were the owner/manager of small firms who were quite familiar with the performance of each of the firm's employees.

The paper analyzes data from a subsample of employers who gave information on two different recent hires for the same job. The 3,412 employers who received the full questionnaire were asked to select "the last new employee your company hired prior to August 1981 regardless of whether that person is still employed by your company." A total of 818 employers could not provide information for a recent new hire. Most of these firms were small organizations that had not hired anyone in recent memory. The employers that provided information

on one new hire were asked to provide data on a second new hire in the same job but with contrasting amounts of vocational education. Of the 2,594 employers that provided data on 1 new hire, 1,511 had not hired anyone else in that job in the last 2 years, and 424 had not hired anyone with a different amount of vocational training for that position in the last 2 years. As a result, data are available for 659 pairs of individuals who have the same job at the same establishment. Missing data on specific questions used in the model further reduced the sample used for estimation to about 480. Most of the establishments from which paired data are available are small. Seventy percent have fewer than 50 employees, and only 12 percent have more than 200 employees.1

Each employer surveyed was asked about the training provided to the two new employees, current and starting hourly wage rates and an average rate paid to workers with 2 years of experience, and the productivity of each new hire at various points in their tenure. A copy of the relevant portions of the questionnaire can be found in Exhibit 1 located at the end of the Appendix.

Data were obtained on the amount of time that is devoted to training new employees during their first 3 months. Separate questions were asked about training hours spent in formal training, informal training by management, informal training by co-workers, and watching other do the job.2 For the sample of firms and jobs, the means for the typical worker were as follows:

- Watching others do the job--47.3 hours
- Formal training programs--10.7 hours.
- Informal training by management--51.0 hours
- Informal training by co-workers--24.2 hours

A training time index was constructed that valued and then combined the time invested in training activities during the first 3 months on the job. The management staff member who provided formal and informal training were assumed to be paid 1.5 times the wage of a co-worker and the trainee's time was valued as equal to 0.8 hours of co-worker training time. When supervisors and co-workers are giving informal training to a new employee, the trainee is almost invariably involved directly in a production activity. Employers report that for informal training, the trainees are typically as productive while being trained as they are when working alone. Consequently, informal training is assumed to involve only the investment of the trainer's time. The training

time index is equal to 0.8 times the hours spent watching others do the job plus 1.8 times the hours in formal[3] training plus 1.5 times the hours in training by management plus hours in training by co-workers.[4] The arithmetic mean of this index is 124 hours, implying that the value of the time invested in training a typical new employee in the first 3 months is about 23 percent of the output that a co-worker would produce in 3 months.

The survey asked the employer (or in larger firms the immediate supervisor) to report on productivity of the typical individual hired in the job after 2 weeks, 12 weeks, and at the end of 2 years at the firm. The supervisor was asked to place a rating on a "scale of zero to 100 where 100 equals the maximum productivity rating any of your employees in (NAME's) position can obtain and zero is absolutely no productivity by your employee." The mean values of these indexes of reported productivity were as follows:

- First 2 weeks--49.0
- Next 10 weeks--64.6
- After 2 years--81.4

The interview questions about the productivity of recently hired employees were intended to provide indicators of the relative productivity of one worker at different points in time or two different workers in the identical job. They do not attempt to measure productivity in any absolute sense and therefore are not comparable across firms or across jobs in a firm. The question asking for a rating of the productivity of particular workers have remarkably low nonresponse rates. Only 4.4 percent of respondents asked about a particular new hire's productivity during the first 2 weeks responded with a "don't know" or refused to answer. Comparably defined nonresponse rates for other questions about the new hire were 8.2 percent for previous relevant experience, 3.2 percent for age, 6.7 for education, 8.6 percent for time spent in informal training by a supervisor, and 5.7 percent for a 3-question sequence from which starting wage rate is calculated. The low nonresponse rate implies that our respondents felt that they were capable of making such judgments and augurs well for the quality of the data that results.

In the paper, it is assumed that these productivity indexes are proportional transformations of true productivity plus a random error. If employer reports of a worker's productivity are equal to an unknown constant times the worker's true marginal product plus a random error, percentage differences in

cell means of the productivity index can be interpreted as unbiased estimators of percentage differences in true productivity. If the variations in the productivity scores assigned by supervisors exaggerate the proportionate variations in the true productivity, our estimates of percentage impacts of productivity on the wage or turnover will be biased downward. Errors in measurement will have the same effect. Even though it is possible for a worker's true productivity to be negative, the scale was defined as having a lower limit of zero. Floors and ceilings on a scale typically cause measurement errors to be negatively correlated with the true value. If this were the case, the result would be an understatement of percentage differences between the productivity of different categories of new hires and the measurement error bias would be mitigated somewhat. In our view, this latter type of bias is more likely than the former.

The fact that the employer is reporting on the past productivity of particular employees may generate biases in data. Some of these employees quit or were fired and some were promoted. These events might influence our respondent's memory of how productive the worker was initially and in the weeks preceding a separation. If this occurs, it would magnify the relationship between productivity and the wage rate and turnover outcomes. This would strengthen the paper's main conclusion that wage rates only partially reflect productivity differentials within the work group.

NOTES

1. Note that the sample is representative of on-the-job training provided by a group of employers, not the training activity associated with the employment of a group of job seekers during a specified time frame. The sample most likely underrepresents larger employers if the employment of a group of job seekers over a specified period of time were to be considered.

2. In a few cases, employers reported that more than 520 hours (13 weeks times 40 hours a week) had been devoted to a specific training activity during the first 3 months on the job. Although the new hire might have received training from more than one supervisor, it is unlikely that two trainers were simultaneously in one-on-one contact with the new hire. Consequently, the computer edit of this data changed all reports of more than 520 hours involved in a training activity to 520.

3. The cost of the trainer was assumed to be two-thirds of the foregone productivity, since formal training often involves more than one trainee. Thus $1.8 = (2/3)1.5 + .8$.

4. The index was constructed under an assumption that the four training activities were mutually exclusive. This implies that if the sum of the hours devoted to individual activities is greater than 520, that a reporting error has occurred which overstates investment in training. In the few cases where the sum of hours devoted to training exceeded 520, the training time index was adjusted downward by the ratio of 520 to the sum of the hours reported for individual activities. This procedure reduces the mean of the index by about 10 percent.

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